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10/707,122

11/21/2003

Lawrence A. Clevenger

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07/12/2005

EXAMINER

CHEN, JACK S J

INTERNATIONAL BUSINESS MACHINES CORPORATION

DEPT. 18G

BLDG. 300-482

2070 ROUTE 52

HOPEWELL JUNCTION, NY 12533

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 07/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                        |  |                     |  |
|------------------------------|------------------------|--|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> |  | <b>Applicant(s)</b> |  |
|                              | 10/707,122             |  | CLEVINGER ET AL.    |  |
|                              | <b>Examiner</b>        |  | <b>Art Unit</b>     |  |
|                              | Jack Chen              |  | 2813                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 02 May 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) 11-24 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 November 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)               | Paper No(s)/Mail Date. _____  |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>11/21/03, 12/22/03</u> .  | 6) <input type="checkbox"/> Other: _____                                    |

### **DETAILED ACTION**

In response to the communication filed on May 2, 2005, claims 1-24 are active in this application.

Applicant's election with traverse of the invention of Group I, Species I, species combination A1, B1, C1, D1, E1, F1, with claims 1-11 and 23 indicated by Applicant to read thereon, in the reply filed on May 2, 2005 is acknowledged. The traversal is on the ground(s) that the species combinations are readily evaluated in one search without placing undue burden on the Examiner. This is not found persuasive because this proposed process shows numerous species combinations that would require a diversity field of search, and it would require undue burdensome search to examiner all of the species combination.

The requirement is still deemed proper and is therefore made FINAL.

While Examiner acknowledges that Applicant indicated that claims 11 and 23 read on the elected species combination, claim 11 is drawn to non-elected species E2 and is hereby withdrawn from further consideration therefor. Similarly, claim 23 is drawn to non-elected species F2 and is hereby withdrawn from further consideration therefor. Furthermore, claims 3-5 are not proper for Markush groups since the term "comprising" is used.

Claims 11-24 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected species, there being no allowable generic or linking claim.

### ***Information Disclosure Statement***

The information disclosure statements filed on 11/21/03 and 12/22/03 have been considered.

### ***Drawings***

Figures 1A-2B should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

### ***Specification***

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### ***Claim Rejections - 35 USC § 112***

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Re claim 1, lines 8, 10 and 13, the term “aperture” should change to –interconnect aperture--.

Re claim 2, line 4, the term “aperture” should change to –interconnect aperture--.

Re claim 4, line 2, the phrase “first and second liners” lacks antecedent basis.

Re claim 4, line 2, the phrase “the dielectric structure” lacks antecedent basis.

Re claim 5, line 1, the phrase “the gas” lacks antecedent basis.

### ***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-5 are rejected under 35 U.S.C. 102(e) as being anticipated by Malhotra et al., U.S. Pub. No. 2004/0115928 A1.

Malhotra et al. disclose a method for forming an interconnect structure, which comprises providing a lower electrical contact including a lower interconnect member 14 (fig. 1A);

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depositing an ILD 18 and forming an interconnect aperture 20 therein extending down to make contact with said lower interconnect member (fig. 1B); depositing a liner layer 24 in said aperture (fig. 1B); removing said liner layer on at least the bottom surface of said aperture (fig. 1C), thereby exposing a top surface of said lower interconnect member; removing material from the interface of said lower interconnect member and the bottom surface of said aperture, thereby forming a second aperture (fig. 1C, i.e., recess within 14) within said lower interconnect member; and depositing conductive material 26/28 in said interconnect aperture, thereby establishing a joint between said lower interconnect member and an upper interconnect member formed by said conductive material in said interconnect aperture (fig. 1D), see figs. 1A-2D and pages 1-4 for more details.

Re claim 2, further comprises removing said liner layer on horizontal surfaces of said interconnect aperture (paragraph 30), including said bottom surface of said aperture (fig. 1C, paragraph 29); and said step of removing material from said lower interconnect member removes material in a shape having substantially no horizontal surfaces (fig. 1C, i.e., the layer 24 on the bottom of the recess is removed); depositing a second liner layer 26 on horizontal surfaces of said interconnect aperture (fig. 1C).

Re claim 3, the material of said lower interconnect member 14 is selected from the group comprising Cu, W, Al and other conducting materials (fig. 1A, paragraph 26).

Re claim 4, due to 112 problems, as best can be understood by the examiner is as following: the material of said liner 24 is selected from the group comprising TaN, Ta, Ti, Ti(Si)N and W (fig. 1B, paragraph 28).

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Re claim 5, the gas for ion bombardment is selected from the group Ar, He, Ne, Xe, N<sub>2</sub>, H<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>H<sub>2</sub> (paragraph 29 and 31).

6. Claims 1, 3-5 are rejected under 35 U.S.C. 102(e) as being anticipated by Rozbicki et al., U.S./6,607,977 B1.

Rozbicki et al. disclose a method for forming an interconnect structure, which comprises providing a lower electrical contact including a lower interconnect member 211 (fig. 2B); depositing an ILD 215 and forming an interconnect aperture therein extending down to make contact with said lower interconnect member (fig. 2B); depositing a liner layer 223 in said aperture (fig. 2C); removing said liner layer on at least the bottom surface of said aperture (fig. 2D), thereby exposing a top surface of said lower interconnect member; removing material from the interface of said lower interconnect member and the bottom surface of said aperture, thereby forming a second aperture within said lower interconnect member (fig. 2D); and depositing conductive material 231 in said interconnect aperture, thereby establishing a joint between said lower interconnect member and an upper interconnect member formed by said conductive material in said interconnect aperture (fig. 2E), see figs. 1A-3G and cols. 1-18 for more details.

Re claim 3, the material of said lower interconnect member 211 is selected from the group comprising Cu, W, Al and other conducting materials (fig. 2B, col. 7, lines 20-25).

Re claim 4, the material of said liner is selected from the group comprising TaN, Ta, Ti, Ti(Si)N and W (col. 7, lines 43-50).

Re claim 5, the gas for ion bombardment is Ar (i.e., col. 12, lines 40-43).



***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

9. Claims 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Malhotra et al., U.S. Pub. No. 2004/0115928 A1.

Malhotra et al. disclosed in above; however, Malhotra et al is silent to the shape of the second aperture, such as cone shape having a height greater than the radius (i.e.,  $3^{0.5}$  times the radius). However, the specification contains no disclosure of either the critical nature of the claimed shaped (i.e. height greater than the radius) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).



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Furthermore, the radius and height of claims 6-10 are considered to involve routine optimization, absent evidence of disclosure of criticality for the range giving unexpected results are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature, radius, height and concentration would have been obvious. See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman* 66 USPQ 308 (CCPA 1945); *In re Swenson* 56 USPQ 372 (CCPA 1942); *In re Sola* 25 USPQ 433 (CCPA 1935); *In re Dreyfus* 24 USPQ 52 (CCPA 1934).

Therefore, the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to select any suitable shape for the second aperture in the method of Malhotra et al. in order to provide interconnection of the upper wires.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Chen whose telephone number is (571)272-1689. The examiner can normally be reached on Monday-Friday (9:00am-6:30pm) alternate Monday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead can be reached on (571)272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Jack Chen  
Primary Examiner  
Art Unit 2813

July 11, 2005